5G-Symposium Rechts der Isar

5G: Mobile Telekommunikation - Schrittmacher für die Chirurgie 4.0

Dr. Walter Weigel
VP & CSO European Research Institute
München, 13.4.2018
Huawei: Leading ICT Products, Solutions & Services

- **Hundreds of millions of consumers**
  - Consumer Products & Services
  - A brand loved by global consumers

- **Global carriers**
  - Carrier Products & Services
  - Best strategic partner for carriers

- **Global enterprises, industries**
  - Enterprise Products & Services
  - Enabler and preferred partner for digital transformation

- **Global cloud users**
  - Cloud Products & Services
  - An open, reliable cloud platform

- **Top 3 in smartphone market share**
  - 14.3%
  - 21%

- **70%+ of revenues from global top 50 carriers**

- **197 companies in Fortune Global 500**
- **45 companies in Fortune Global 100**

- **94 cloud services in 13 categories**
- **50+ solutions**

- **Serving global industries/large enterprises**

- **Fast growth, reliable and secure services for customers**

- **Global January to September, 2017**
- **China May, 2017**
Hypothesis: 5G and IT as most important enabler of verticals

VR: the Next Social Platform
— Zuckerberg keynotes in MWC2016

Cloud access anywhere at 1Gbps

Critical Industries Connected

Connected Car  Smart Manufacturing  Smart Grid  e/m Health

Y2025: 100 Billion
10B People
90B Things

Smart Cities
5G opens the road to mobile broadband and Internet of Things

- 1 ms E2E latency (radio)
- 10Gbps per connection
- 1,000K connections per km²
- 500km/h high-speed
- Slicing network architecture

Goal: One Network Fits All Applications with High Flexibility
Usage scenarios of IMT for 2020 and beyond (5G)

Enhanced Mobile Broadband
- Gigabytes in a Second
- 3D video, UHD Screens
- Work and Play in Cloud
- Augmented Reality
- Industry Automation
- Mission Critical Application
- Self Driving Car

Future IMT

Massive Machine Type Communications
- 100 Billion Connections
- 1 Millisecond Latency
- 10 Gbit's Peak Speed

Ultra-Reliable and Low-Latency Communications

New Air Interface
- Flexibility & Spectrum Efficiency

New Architecture
- One Physical Network Multiple Industries
5G in reality: Car field trial in Munich, Germany

**Location Garching (north of Munich)**
- Indoor and outdoor / parking garage
- Access to highway A9

**TUM site / Arcisstrasse**
- Urban scenario, small streets
- Test of V2x, MTC, 5G Positioning

**Bundeswehr-Hochschule Neubiberg**
- Test of V2x, MTC, 5G Positioning
- On demand site used for V2x tests

**MRI Clinic rechts der Isar**
- indoor/outdoor
- Person/Object tracking, Robot for e-health

**Site setup**
- Testing of 5G features
- Close to Mall, sub urban, outdoor
- Test of LTE-V and 5G V2x

**Lab and server farm**
- Testing of 5G features
- Core Network and SDN/NFV test capabilities

Supported by the Bavarian Ministry of Economics

Supported by the German Ministry of Transport

PROVIDENTIA Project

**GRC**

**ERI**

**OEZ**

**TUM**

**North**

**Garching**

**München**

**Indoor and outdoor / parking garage**

**Access to highway A9**

**On demand site used for ToD**
5G Car to Car communication: Cooperative Emergency Brake

Different parameters for delay and reliability
Starting distance between cars: 1.60m

<table>
<thead>
<tr>
<th>Radio delay ms</th>
<th>Packet delivery rate %</th>
<th>Error rate %</th>
<th>Distance in m</th>
<th>result</th>
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<tbody>
<tr>
<td>100</td>
<td>90</td>
<td>10</td>
<td>-0.4</td>
<td>crash</td>
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<tr>
<td>100</td>
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<td>+0.45</td>
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<td>100</td>
<td>0</td>
<td>1.38</td>
<td>ok</td>
</tr>
</tbody>
</table>

Distance between cars

- No safety distance
- Small margin
- Good safety distance
- Very stable safety distance
Vision: Comprehensive systems integration in the hospital

Source: Professor Dr. Hubertus Feussner
Different equipment of different producers are not connected – use a paper print

- Insulin pumps, Infusion pumps – What are they pumping? Are they working properly?
- Value assets such as monitors, defibrillators, wheelchairs, surgical equipment – Where are they? What is the status of their maintenance cycle?
- High value drugs and medical consumables – Are there any goods which might go beyond the expiry date if not used today and if so – where are they?

Patients cannot be identified – Risk of unintended procedure or drug error due to mistaken identity?

Medicaments are not electronically traceable – How much do we have? When do we need to order?

High value drugs and medical consumables – Are there any goods which might expire if not used today? – If so, where are they?

Automated monitoring of coolers in pharmacies

Smart Pharmaceuticals for „Personalised Care“
Use case:
Local diagnostic requires advice from a remote expert
Remote expert shall be able to control the robot for perfect adjustment of the tool/camera

Funded by the Bavarian government, partners MRI and TUM
5G in the Health Industry: smart medicaments

- 150 million connected inhalers required in China to cover patients with Asthma/COPD
- 100 million connections to cover Diabetes in Africa by 2035
- 250 million connections to cover Diabetes required in South-East Asia by 2035
- 120 million connections required to cover Diabetes in the Middle East and Northern Africa by 2035
- 400 million connections required to cover Diabetes in the Western Pacific Region by 2035
- Solution: Smart medicament with sensors connected via 5G to the cloud
- Enabling big data analytics

Source: Professor Dr. Christoph Thuemmler
Radio: The importance of spectrum for 5G

**Primary bands**

Below 1 GHz
- 470-694 MHz
- 694-698 MHz
- 698-790 MHz
- 1427-1518 MHz

**Complementary bands**

For additional capacity

- New global mobile allocations in WRC-15
- Short/Medium term regional opportunities
- Long term opportunities

**Group 30**
- 24.25 - 27.5 GHz
- 31.8 - 33.4 GHz

**Group 40**
- 37.0 - 40.5 GHz
- 40.5 - 42.5 GHz
- 42.5 - 43.5 GHz

**Group 50**
- 45.5 - 47 GHz
- 47.0 - 47.2 GHz
- 47.2 - 50.2 GHz
- 50.4 - 52.6 GHz

**Group 80**
- 66 - 76 GHz
- 81 - 86 GHz

+ current 2G/3G/4G IMT bands through re-farming /migration to 5G
+ unlicensed bands

**In scope of WRC-19, allocated to Mobile Service already**

**In scope of WRC-19, may require allocation to Mobile Service**

**Not in scope of WRC-19**
• **Outdoor coverage**
  - The figure shows the path loss model for different frequency ranges
  - Typical maximum allowed path loss: ca. 140 dB
  - Significant differences in terms of coverage recorded across above and below 6GHz ranges

Source: channel model up to 100 GHz (3.5GHz path loss curve is calibrated with field measurements) - NTT DoCoMo, Huawei, et al. see whitepaper "5G channel model for bands up to 100 GHz" March 09, 2016 - www.5gworkshops.com

• **Outdoor to indoor (O2I) coverage**
  - The figure shows different materials’ penetration loss for different frequency ranges
  - Concrete wall has very high penetration loss
  - O2I coverage is very limited for high frequencies in dense urban environments
5G Core Network: processing of many different data streams

Paradigm shifts in the future core networks:
- Cloud networking
- Software defined functions and slicing
- Automatic optimization

Goal: A common core network for different applications
To achieve common solutions: Standardization is Key

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<th>Industry Standards</th>
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<td><strong>Chip/Module</strong></td>
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<td>3GPP</td>
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Summary

- We could show that 5G is suitable for health-care applications
- It solves issues with latency, bandwidth and reliability
- One use case is in the operating theatre of the future
- Munich and Bavaria are an excellent venue for such a project due to
  - Excellent academic partners
  - Top companies in the required fields of expertise
- We are discussing a new project which will build on the results of the current project
THANK YOU